

carrying out with models, for the Admiralty, are gradually accumulating the data required on this branch of the subject.

I wish in conclusion to insist again, with the greatest urgency, on the hopeless futility of any attempt to theorise on goodness of form in ships, except under the strong and entirely new light which the doctrine of stream-lines throws on it.

It is, I repeat, a simple fact that the whole framework of thought by which the search for improved forms is commonly directed, consists of ideas which, if the doctrine of stream-lines is true, are absolutely delusive and misleading. And real improvements are not seldom attributed to the guidance of those very ideas which I am characterising as delusive, while in reality they are the fruit of painstaking, but incorrectly rationalised, experience.

I am but insisting on views which the highest mathematicians of the day have established irrefutably; and my work has been to appreciate and adapt these views when presented to me.\*

No one is more alive than myself to the plausibility of the unsound views against which I am contending; but it is for the very reason that they are so plausible that it is necessary to protest against them so earnestly; and I hope that in protesting thus, I shall not be regarded as dogmatic.

In truth, it is a protest of scepticism, not of dogmatism; for I do not profess to direct anyone how to find his way straight to the form of least resistance. For the present we can but feel our way cautiously towards it by careful trials, using only the improved ideas which the stream-line theory supplies, as safeguards against attributing this or that result to irrelevant or, rather, non-existing causes.

(To be continued.)

#### THE CHANNEL TUNNEL—SUBMARINE EXPLORATIONS†

AN important Report in connection with the proposed Channel Tunnel has just been issued by the French Submarine Railway Association, giving the results of a detailed examination of the French coast, and of soundings taken in the bed of the Channel during the past autumn. The subject has on previous occasions been referred to in the pages of this Journal;‡ but before giving an account of the recent explorations it may be well briefly to refer to what has already been done.

A tunnel under the Channel has long been talked of, and many schemes have been brought forward; but the only one which has been received with general favour is that of Sir J. Hawkshaw, who proposes to carry the tunnel from the South Foreland to near Sangatte. In 1864 Mr. E. C. H. Day was employed by Sir J. Hawkshaw to make a geological survey of the neighbouring coasts with the view of obtaining some guide as to the probable outcrops beneath the Channel; the map thus produced was published with the early statements of the Company. In 1866 borings were made on both coasts to prove the succession of the strata at points near which the tunnel was to leave the shores; that on the shore at St. Margaret's Bay traversed 240 feet of upper chalk and 296 feet of lower chalk, and was stopped in the gault at a depth of 567 feet from the surface. The boring on the French coast was put down a little north of Sangatte; it passed through 70 feet of drift-sand, &c., 190 feet of chalk with flints, 284 feet of chalk without flints, and was stopped at a depth of 551 feet from the surface owing to an accident to the hole. This boring, therefore, did not reach the Upper Greensand, and the depth to this bed was estimated from information obtained in the deep boring at Calais. This accident was unfortunate, because, owing to a misreading of the accounts of the Calais

\* I cannot pretend to frame a list of the many eminent mathematicians who originated or perfected the stream-line theory; but I must name, from amongst them, Prof. Rankine, Sir William Thomson, and Prof. Stokes, in order to express my personal indebtedness to them for information and explanations, to which chiefly (however imperfectly utilised) I owe such elementary knowledge of the subject as alone I possess.

† *Chemin de Fer Sous-Marin entre la France et l'Angleterre. Rapports sur les Sondages exécutés dans le Pas de Calais en 1875.* Fol., Paris, 1875.

‡ Vol. i. pp. 160, 303, 631. Prof. Hébert made a communication to the meeting of the British Association at Bristol, on the folds likely to occur beneath the Channel. (See NATURE, vol. xii. p. 407.)

boring, I believe that the thickness of the lower chalk was considerably over-estimated at Sangatte.

At a later date soundings were taken along the line of the proposed tunnel, and at varying distances to the south-west of that line; the instrument used penetrated the bottom for a few inches, and brought up specimens of the ocean floor. The larger number of these were from the superficial covering (sand, &c.), but many brought up pure chalk, and several specimens of gault were obtained near the English coast. This examination was not detailed enough to test very severely the geological map; but so far as the information went it tended to confirm the previous surveys; the only difference then observed was that the gault appeared to run rather further north towards Dover than would have been expected. But it may be doubtful whether such small borings always give trustworthy evidence on this point. The lowest beds of chalk are very clayey, and when thoroughly saturated with water are often quite dark and bluish in colour. In fact, these lowest beds, when freshly exposed in railway cuttings, have been at first mistaken for gault by good observers.

No further explorations have been made till the present year. The concession to the Company was voted by the National Assembly on the 2nd of August, and was signed by Marshal MacMahon on the 5th of the same month. Anticipating the result of the vote the Company commenced work in July. By means of a steamer, soundings were taken on the bed of the Channel. A tube was fixed at the bottom of the sounding-lead, by means of which specimens were brought up. Various appliances were used, but tubes of from 20 to 22 millimètres in diameter, and 15 to 20 centimètres long were found to give the best results. The number of soundings taken per day varied according to circumstances; it averaged 70 or 80, but sometimes reached 100.

The Commission entrusted with the explorations was presided over by M. Lavalley, and consisted of MM. Delesse, Potier, and Lapparent as geologists, and M. Larousse as hydrographer. The position of the boat was at each observation carefully determined by bearings on landmarks. Every specimen collected was marked and sent to Paris for future determination and reference. In all 1,522 soundings were made; 753 specimens of the bottom were obtained, of which 335 have been determined with certainty.

The results show that the outcrop of the gault makes a bend to the north just off the French coast. The Commission carefully tested this district by divers (the water being shallow), and they believe that this bend is due to an anticlinal fold of the strata, and not to a fault; the dip of the beds probably not exceeding 10°. From the French waters across the Channel as far as the observations went (to within about five miles of the English coast), the beds run with great regularity. Supposing the observations to be trustworthy, there cannot be a transverse fault of any magnitude along this line. But the outcrop of the gault lies further to the south than was expected; in fact, it is striking direct for Folkestone church. As before remarked, the earlier observations showed the gault near the English shore to run a little further to the north than was expected; so that here there must either be a roll of the beds or a fault with a downthrow to the south-east.\* The engineers point out the importance of following up this inquiry, and doubtless it will be done as early as possible next year.

No one has expected to tunnel through twenty miles of chalk without meeting with a fault, and therefore the possibility of encountering one near the English shore need cause no uneasiness. It may give no extra trouble, or yield no more water than the rest of the work. Faults are often cut in coal workings under the sea, but they do

\* Mr. G. H. Kinahan, writing to me last year, expressed his belief in the existence of a considerable fault in the Channel, with a downthrow to the south-east.

not cause any uneasiness or extra expense on this account. For the rest the explorations are highly satisfactory, and the extension southwards of the gault is no disadvantage.

Besides the outcrop of the "craie glauconieuse," which almost corresponds to the outcrop of the gault, the engineers profess to have determined the line between the "craie de Rouen," or lower chalk, and a nodular bed which lies above it. One cannot help feeling doubts as to the possibility of this being done, with any degree of certainty, by the means at their disposal. It is, however, important to fix if possible the breadth of outcrop of one of the beds; because, the thickness being known, we can thus estimate the dip. The soundings, as interpreted by the Commission, show that the dip is greatest near the French coast, and that it gets gradually less towards the English coast. Borings at and near Calais show that the dip there lessens towards the north, and by analogy it may be inferred that towards the proposed tunnel the beds under the sea will also lessen in dip.

It is proposed to continue the soundings further north, with the view of fixing exactly the outcrops of the higher beds of chalk. As the report states, if these attempts are successful we shall know exactly, and not by hypothesis, the geological structure of the strait. We shall know too the geological structure of the bed of the sea better than we now know that of much of the dry land; for no geologist has attempted to trace out all the chalk divisions on either coast; they have been measured in the cliffs, but not mapped in detail inland.

The Commission recommends that a new and larger borehole be put down at Sangatte with the view of testing the water-bearing qualities of the chalk at different levels, and of proving the exact thickness of the chalk. It is proposed to carry the hole through the gault and into the Palæozoic rocks, with the view of testing whether these rocks are absorbent, and capable of carrying off water from the tunnel. The possibility that they may serve this purpose has been suggested by the present writer.\* The Commission proposes to test the point, but observes that it is unlikely to be the case. The Palæozoic rocks yield water near Lille, though they have not done so at Calais and Harwich; this may be because the old rocks are only slightly permeable, and if so they will be only slightly absorbent. It was on this ground that Prof. Prestwich proposed to tunnel through the Palæozoic rocks.

The Commission has examined in great detail the chalk of the French cliffs, and the results of their observations are drawn in a section in this Report. W. Phillips in 1819 published a description of the cliffs on each side of the Channel. So far as his observations go they are exact, and need no correction; later observers having only worked out the beds in greater detail. The Report refers in terms of well-merited praise to this early work of Phillips, but it is slightly in error in stating that English geologists have done nothing since his time. The Geological Survey has been over the ground; the maps are published, and descriptions have been given by Mr. Whitaker. Mr. Dowker has also studied the higher chalk of Kent.

The Report contains a large chart showing the positions of all the soundings, and is further illustrated by sections and diagrams in the text. It is one of the most valuable publications which has yet appeared on this important subject, and is well worthy of the reputation of its distinguished authors.

W. TOPLEY

#### NOTES

It is with great regret that we hear of the death of Mr. R. C. Carrington, F.R.S., whose name is so intimately associated with solar observation, which indeed he was the first to start in this country. His failing health of late years, was no doubt due to his unceasing assiduity. For seven and a quarter

\* Quart. Journ. Science, April 1872.

years scarcely a single day passed that Mr. Carrington did not make an observation on sun-spots. The book which contains these observations, published by Williams and Norgate, partly at the expense of the Royal Society, is one of the astronomical works of which England has good cause to be proud. Up to his death Mr. Carrington was engaged in designing and planning instruments of more than curious construction, which he intended eventually to fit up in his observatory. Before he took up sun-spot observations he constructed charts and a catalogue of the circumpolar stars, into which he introduced the most minute accuracy. The "Redhill Catalogue" will long be consulted by the practical astronomer.

At the meeting of the Royal Society on Thursday last, the following Fellows were appointed Vice-Presidents of the Society for the ensuing year:—Mr. William Spottiswoode, M.A.; Prof. J. Couch Adams, LL.D.; Captain F. J. O. Evans, R.N.; Dr. A. C. Günther, M.A., and Dr. William Pole, C.E.

COUNT SALVADORI, of the Royal Museum of Turin, has recently described in the "Annals of the Civic Museum of Natural History of Genoa," a large new rapacious bird, discovered by the naturalist D'Alberis in New Guinea, which he proposes to call *Harpyopsis novæ Guinææ*. The existence of this bird probably gave rise to the exaggerated report of the enormous "eagles" which were seen during the voyage up an unexplored river in New Guinea, recently published in the *Daily News* (NATURE, vol. xiii., p. 76.)

At Monday's meeting of the Royal Geographical Society the paper read was by Mr. Octavius Stone, on the discovery of the Mai-Kassa or Baxter River, New Guinea. Mr. Stone sailed up the river in the missionary vessel *Ellangowan*, and the account given is essentially the same as that which has already appeared in our journal, though Mr. Stone seems to make no mention of the monstrous bird referred to by Mr. Smithurst (vol. xiii., p. 76.) At the furthest point reached (about 100 miles from the mouth) the Mai-Kassa was ten yards wide, although the depth was still two fathoms. Even so far in the interior it is influenced by four half-tides daily, as when the first waters meet the sea a rebound is caused, so that the second half-tide is of slightly longer duration than the first. The rise of tide at the furthest point is from 3 feet to 4 feet, but its waters are entirely fresh. It is on account of the sluggish motion and continued depth of this river that Mr. Stone believes it may run for another 100 miles into the interior. A boa-constrictor was shot, 15 ft. 3 in. long, having a protuberance in his body 14½ inches in diameter, which, when cut open, proved to be the body of a whole kangaroo only partially digested.

LAST Saturday's meeting at Bristol, under the presidency of the Mayor, in connection with the proposed University College of that city, was quite a successful one. A constitution, sufficiently comprehensive, was adopted, on the basis of which the general committee were empowered to incorporate the college, and to prepare the necessary legal documents. Thus the college may now be regarded as fairly set afloat, and judging from the enthusiasm of the meeting we should think it likely that it will soon be at work. Out of 40,000*l.* which were wanted, 22,000*l.* have been collected mainly in Bristol and neighbourhood; besides which, it is stated, some colleges at Oxford are willing to give 1,000*l.* a year towards University teaching at Bristol. Among those who spoke were Prof. Jowett and the Rev. Mr. Robinson, of New College, Oxford.

We are authoritatively informed that the delay which has this year taken place in the zoological publications of the Linnean Society will not occur again, and has depended on causes over which the zoological secretary has no control, and for which he is not responsible.